

**TECHNICAL REVIEW AND EVALUATION
OF APPLICATION FOR
AIR QUALITY PERMIT NO. 42169**

I. INTRODUCTION

This Class II, synthetic minor air quality control operating permit is for the operation of a slag processing facility in Clarkdale, Yavapai County, Arizona. The facility is owned and operated by Clarkdale Metals Corp. This permit is for the Demonstration Module, which will process a maximum of 240 tons of slag per day, and 87,600 tons per year.

Company Information

Facility Name:	Clarkdale Slag Project
Facility Location:	500 Luke Lane, Clarkdale, AZ 86324
Mailing Address:	P.O. Box 910 Clarkdale, Arizona, 86324

Background

Clarkdale Metals Corp. (CMC) is proposing to construct a slag processing facility in Clarkdale, Arizona. A Demonstration Module is proposed to prove the viability of the process prior to the commencement of the final design of the planned full scale facility. The products produced at the facility include copper, zinc, silver, gold, and iron. Depending on the success of this smaller operation, CMC plans to expand its operation to accommodate approximately 2,000 tons of slag per day and 730,000 tons per year. This permit addresses only the Demonstration Module and not the full build-out.

II. PROCESS DESCRIPTION

A. Mining and Primary Crushing

CMC will recover material to process from an existing on-site slag pile. A bulldozer or an excavator will rip the in-situ slag. The ripped slag Run-of-Mine (ROM) material will be delivered by a front-end loader to the primary crushing plant. The portable crushing plant will be located near the center of the slag pile. The ROM slag will be reduced to about 83% minus 1-inch size. Crushed material will be sent to a screening operation, while material larger than 1 inch in diameter will be returned to the jaw crusher. The metallurgical Demonstration Module is designed to handle 240 tons per day (tpd). The primary crusher will have a capacity of about 25 tons per hour (tph) of slag. The primary crushing plant will only crush ROM for a maximum of 10 hours per day, during the day shift only. It will take a haul truck a maximum of 8 hours each day to transport the crushed slag to the crushed slag storage facility. Fugitive dust in the active mining area will be controlled by the use of a dedicated water truck. The portable crushing plant will be equipped with water sprays to control dust generated by the crushing operation.

B. ROM Slag Storage

After primary crushing, the minus 1-inch material is transported to the crushed slag stockpile via truck. The storage pile has been designed with excess capacity to ensure that enough slag is available to operate the process facility for over 24 hours, while the stockpile is being filled during the day shift.

C. Secondary Crushing

The 83% minus 1-inch slag will be withdrawn from the stockpile and transported by a front end loader to the feed hopper equipped with water spray bars. The slag is then conveyed by the CamWall Conveyor #1 to the Weigh Belt Feeder and then enters the building via the CamWall Conveyor #2. From the CamWall Conveyor #2 the slag enters the feed bin of the secondary impact crusher located inside the Demonstration Module building. All of the CamWall conveyors will be constructed of carbon steel and totally enclosed. A small bag type, reverse pulse jet dust collector (1,300 cfm, 99.9% efficiency) will be connected to the crusher and directly ducted to the material transfer points within the enclosed CamWall conveyors to collect fugitive dust. Minus 1-inch slag will be reduced to approximately 20-mesh by the crusher. The 20-mesh slag will report to an enclosed elevating/conveying system and introduced into the vibratory grinding mill. Water will be added to the 20-mesh slag as it enters the grinding mill. The introduction of water at this point will produce a wet slurry and will preclude the release of any fugitive dust from this point on through the entire process.

D. Tertiary Grinding

The vibrating grinding mill will have a capacity to process 10 tph or 240 tpd. The mill has the ability to reduce the 20-mesh feedstock to 200-mesh. Operating parameters established by CMC production personnel will determine the degree to which the mesh size of the slag is actually reduced. No fugitive dust will be produced by the grinding operation because of the wet slurry being processed. The ground slag will be screened to remove any oversize material, and will then be discharged into an agitated pump feed tank.

E. Ground Slag Leaching

The ground slag will report to a series of agitated leaching vessels. Several different chemicals will be introduced to the process stream in these vessels. Sulfuric acid (H_2SO_4) is added for pH control and is consumed at a maximum hourly rate of 33.8 gallons per hour, but typically less than 20 gallons is consumed per 10-tons of slag processed.

The oxidants are Calcium Hypochlorite ($\text{Ca}(\text{OCl})_2$) and BioCide Jel or Granules (Bromochlorodimethylhydantoin)-(BCDMH), and a lixiviant-Sodium Bromide (NaBr). The oxidants are also sources of halides (i.e., chlorine and bromine) for leaching.

Maximum hourly consumption rates of calcium hypochlorite, biocides, and sodium bromide are estimated to be 80 pounds per hour, 10 pounds per hour, and 20 pounds per hour, respectively. The purpose of the chemicals is to adjust the solution pH, control the oxidation reduction potential (ORP) of the solution and to dissolve the metals contained in the slag.

No air pollutants are created during the leaching of the metals, because the chemicals are used at their lowest concentrations and are consumed. Due to the high ORP there is no “free” chlorine (Cl_2) or bromine (Br_2) released into the atmosphere because they are immediately oxidized to hypochlorous acid (HOCl) and hydrobromous acid (HOBr) in solution. The sulfuric acid reacts with the calcium oxide (CaO) and magnesium oxide (MgO) to form sulfates, which precipitate out of the solution and end up as solids in the leach slurry.

The leached slurry will be sent to a pressure filter. The filter cake will be thoroughly washed with water to ensure that all of the chemicals and dissolved metals are removed from the filter cake. The washed filter cake will be transported via a belt conveyor to containers/bags. It is anticipated that any potential fugitive emissions caused by bagging operations will be negligible because the cake will still contain a nominal amount of moisture. Material will be loaded from

the hopper into containers and/or “super sacks” for transport to end users. The semi-dried filter cake can be utilized as an additive to concrete, as landfill and for other uses.

Pregnant solution (filtrate from the pressure filter) will be pumped to pregnant solution holding tanks. Solution from the holding tanks will be pumped to a series of ion exchange resin columns to recover the dissolved metals.

F. Metal Recovery

1. Gold/Silver Production

The pregnant solution will first be processed through resin columns designed to recover dissolved gold and silver. The gold and silver occur as gold/silver bromide ion complexes (AuBr_4^- and AgBr_2^-).

The gold and silver recovery system will consist of several columns and associated ancillary pumps/tanks. The precious metals will load onto resin beads. Once the beads are loaded, they will be recovered from the column and prepared for shipment to an off-site refinery for further processing. There are no air pollutant emissions associated with this process step.

2. Copper Production

The process solution containing copper (II) chloride (CuCl_2) and zinc (II) chloride (ZnCl_2) from the previous step, which is now barren of dissolved gold and silver, will be pumped to a solution tank for recovery of dissolved copper.

The copper recovery system will consist of several columns and associated ancillary pumps/tanks. The copper ion complex will load onto resin beads. Once the beads are loaded, they will be stripped and the loaded solution (pregnant solution) will be pumped to a small electrowinning circuit for the recovery of copper metal.

The resin column operation is totally enclosed and there are no air pollutant emissions associated with this process step. The small electrowinning cells have small tanks completely covered with polypropylene “floats” that are hexagon shaped and fit together and interlock to form a tight floating cover on the surface of the electrolytic cell. This is a common method used for the control of mist in small systems.

3. Zinc Production

The process solution containing zinc chloride from the previous step, which is now barren of dissolved gold, silver and copper, will be pumped to the zinc chloride holding tank. The zinc will then be recovered in the same manner as previously described for the copper. The zinc recovery system will consist of several columns and associated ancillary pumps/tanks. The zinc ion complex will load onto resin beads. Once the beads are loaded, they will be stripped and the loaded solution (pregnant solution) will be pumped to a holding tank for the recovery of zinc.

The resin column operation is totally enclosed and there are no air pollutant emission associated with the process step. At this point, either Na_2S can be added to the zinc solution to produce ZnS as a solid, or calcium oxide (CaO), soda ash (Na_2CO_3) or caustic soda (NaOH) can be added to produce zinc hydroxide (Zn(OH)_2) as a solid. The solids will be filtered off, washed and bagged for shipment.

G. Processed Slag Reuse

Process solution bleed streams will be used to control mineral build-up. Milk of lime will be added to the bleed streams in a thickener tank to precipitate calcium, magnesium and other minerals. The thickened precipitate will be processed over a filter. The de-watered bleed stream filter cake will be conveyed by belt conveyor for inclusion in the leached slag filter cake, which is barren processed slag available for reuse. The neutralized and de-mineralized filtrate will be pumped to a water storage tank. The filtrate water will be re-used in the process.

III. EMISSIONS

The material handling processes (crushing and screening, conveyors, etc.) emit particulate matter with a diameter of less than 10 microns (PM₁₀). The Clarkdale Slag Project has the potential to emit, after controls, 1.54 tons per year of PM₁₀.

IV. APPLICABLE REGULATIONS

Table 2, below, displays the applicable requirements for each piece of equipment under this proposed permit.

Table 2: Verification of Applicable Regulations

Unit	Date of Constr./Mod.	Control Device	Rule	Verification
Metallic Mineral Processing	N/A	Water spray, dust collector	A.A.C. R18-2-721, A.A.C. R18-2-702	721 contains PM limits for Crushing, Screening, and other material handling operations. 702 contains an opacity limit.
Electrowinning Facility	N/A	Floats to control acid mist emissions	A.A.C. R18-2-730	Conditions applicable to all unclassified sources.
Fugitive dust sources	N/A	Water and other reasonable precautions.	AAC R18, Article 6	These standards are applicable to all fugitive dust sources.
Mobile sources	N/A	Water Sprays/Water Truck for dust control	AAC R18, Article 8	Opacity requirements for smoke and dust for mobile sources (construction equipment, etc.).

V. MONITORING AND RECORDKEEPING REQUIREMENTS

A. Metallic Mineral Processing

The Permittee is required to conduct observations every two weeks of the various point and non-point sources. If the opacity appears to exceed the relevant standard, the Permittee is required to conduct a 6-minute Method 9 observation. The Permittee is required to keep records of all observations and results.

B. Electrowinning

The Permittee is required to keep records of all emission control techniques employed in the EW process.

C. Fugitive Dust Sources

The permit specifies opacity limits for the fugitive dust sources. The Permittee is required to keep records of all activities that may produce fugitive dust emissions of particulate matter.

VI. INSIGNIFICANT ACTIVITIES

In the permit application, CMC proposed that several activities be classified as insignificant activities under A.A.C. R18-2-101.57. Table 3, on the following page, lists the proposed insignificant activities at the CMC Clarkdale Slag Project, along with the Department's determination as to whether or not the activity qualifies as insignificant.

Table 3: Insignificant Activities

Equipment Description	Number of Equipment Items	Maximum Size or Capacity	Verification of Insignificance
Slurry agitators	30	200 gallons each	A.A.C. R18-2-101.57.j
Slurry agitators	200	500 gallons each	A.A.C. R18-2-101.57.j
Sulfuric acid makeup tanks	7	100 gallons	A.A.C. R18-2-101.57.j
Splitter tanks	7	100 gallons	A.A.C. R18-2-101.57.j
Vacuum receiver tanks	14	200 gallons	A.A.C. R18-2-101.57.j
Solution holding tanks	28	1,000 gallons	A.A.C. R18-2-101.57.j
Cu/Zn resin columns	60	5 cubic feet	A.A.C. R18-2-101.57.j
Au/Ag resin columns	6	2 cubic feet	A.A.C. R18-2-101.57.j
Elution chemical tanks for Cu/Zn recovery	28	200 gallons	A.A.C. R18-2-101.57.j
Precipitation/Bleed water thickener	1	150 gallons	A.A.C. R18-2-101.57.j
Lime mix tank	1	100 gallons	A.A.C. R18-2-101.57.j
Milk of lime holding tank	1	100 gallons	A.A.C. R18-2-101.57.j
Neutralization tank	1	150 gallons	A.A.C. R18-2-101.57.j
Chemical makeup tanks	7	100 gallons	A.A.C. R18-2-101.57.j
Electrowinning cell	2	2' 6" x 10' 0"	Not insignificant – subject to A.A.C. R18-2-730
Pressure/vacuum filters	2	35 GPM	A.A.C. R18-2-101.57.j
Belt filters	2	4' x 30'	A.A.C. R18-2-101.57.j
Reagent feed tanks	4	55 gallons	A.A.C. R18-2-101.57.j
Strong acid storage tank	1	5,000 gallons	A.A.C. R18-2-101.57.j
Strong acid day tank	1	600 gallons	A.A.C. R18-2-101.57.j
Landscaping, building maintenance, or janitorial activities	N/A	N/A	A.A.C. R18-2-101.57.a
Diesel and fuel oil storage tanks	N/A	< 40,000 gallons	A.A.C. R18-2-101.57.c
Hand held or manually operated equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding, or turning of precision parts, metals, plastics or wood	N/A	N/A	A.A.C. R18-2-101.57.f

Equipment Description	Number of Equipment Items	Maximum Size or Capacity	Verification of Insignificance
Internal combustion engine-driven compressors, ICE-driven electrical generator sets, and ICE-driven water pumps used only for emergency replacement or standby service	N/A	N/A	Not insignificant - subject to A.A.C. R18-2-719 requirements, but there are not any ICEs at this facility.
Lab equipment used exclusively for chemical and physical analyses	N/A	N/A	A.A.C. R18-2-101.57.i

VII. AMBIENT AIR IMPACT ANALYSIS

CMC conducted an Ambient Air Impact Analysis to demonstrate protection of the National Ambient Air Quality Standards (NAAQS). The only predicted impact is from PM₁₀, with a maximum predicted concentration that is 60% of the NAAQS 24-hour limit.